

ON STAR CHAINS AND DARK FILAMENTS IN GALACTIC NEBULAE

By V.G.Fessenkov (Astrophysical Institute, Alma Ata)

When investigating sufficiently dense star fields one often finds some short currents of stars oriented with a certain regularity and in a few cases connected with dark filaments of the galactic nebulae. Yet it is necessary to be very cautious in the interpretation of this phenomenon, because even completely accidental clustering of some objects can sometimes lead to interesting deviations from homogeneity.

This can be illustrated by the artificial star fields obtained by us in the following manner. 400 black cards 3,5 x 3,5 cm in size were prepared. Every card was successively placed between electrodes of the Runkorf coil and perforated during some time by means of electric discharges. The position of the card may be continually changed during the exposition. The direction of the spark is determined by random fluctuations in conductive air layer between the electrodes. Each card becomes perforated owing to this procedure by nearly 250 extremely small holes. These cards were further successively exposed with a certain magnification on the same photographic plate. Negatives with many thousands black dots of very minute sizes were obtained in this manner; the superposition of several negatives prepared independently permit to obtain an artificial star field containing 100 000 or even more "stars" on the area of 10 x 10 cm.

Another method, perhaps a more trustworthy one, but much more slow, consists in denoting the rectangular coordinates obtained by means of registration of the position of a small ball in a rotating wheel (roulette).

The artificial star fields obtained in such a manner are characterised by noticeable irregularities. Sometimes short chains containing few stars and even oriented parallel to other similar chains in their close proximity are present.

- 2 -

The fluctuations of density, i.e. the fluctuations in the number of stars per unit area occur always, as it may be predicted with fair exactness, by the probability theory. Nevertheless these fields of accidental objects never show any systematic streaming on a considerable area, as well as chains with intervals between the components much smaller than the mean distance between the stars of a given field. This artificial field is represented as an example in Fig. I. An area of 10 x 10 cm contains nearly 50 000 small dots distributed quite arbitrarily.

It may be concluded that only very close stellar chains may be considered with high probability as physically connected. But even in this case some additional arguments must be advanced in favour of this conclusion.

Figure 2 represents an example of a short chain containing about 7 stars very closely together and apparently of the same colour. This object was photographed with the Maksutov telescope of the Alma Ata Astrophysical Observatory. It is situated in the neighbourhood of the galactic nebula NGC 281 and its coordinates are

$$\alpha = 0^h 47^m.4 \quad \delta = 56^{\circ}3'$$

The scale of the figure is 1' in 13.8 mm.

Analogous star chains are present in different parts of the sky, especially near the dark galactic nebulae. Very often they are intimately connected with extremely elongated dark filaments following them at some length. As a sufficiently conspicuous example the region of the gaseous nebula McDonald 12 in Cygnus can be indicated. (See Fig. 3).

One can easily see numerous dark filaments in the same, approximately West-East direction. The width of these filaments is nearly 1'. One of them represents a narrow continua-

- 3 -

tion of a very outstanding dark lane of the same orientation in the northern part of the picture.

In some parts of these filaments and at their border very narrow star chains are located, whose components are nearly of the same colour. This can be demonstrated by comparing the photographs taken in red and blue light, for instance by comparing the plates of the Palomar Atlas of the corresponding parts of the sky. Figure 4 represents our evaluation of the stellar magnitudes of five different star chains in the region of McDonald 12, using the charts of the Palomar Atlas. Some of these chains are indicated in Fig.3, and more clearly in Fig.5 (scale 20"/mm).

It may be noted that the colour of all stars belonging to the same chain is almost always the same. Moreover, it is stated that bright star chains, namely of 13-14 mg are characterised by a small colour index corresponding to type A, but the fainter chains are considerably redder in appearance, namely have a colour index equal to one or even one and a half.

What is the probability that these star chains are physically real? As it was previously shown this probability in a very dense star field is very small from the statistical point of view. But in reality we have some additional evidence pointing in favour of physical connections between the components of the same chain, namely the similarity in colour and the apparent connection with the dark filaments. This was also indicated recently by Prof. Martynov (I).

Nevertheless if these systems are generally not accidental agglomerations of stars, then they must be unstable and consequently very rare. Purely random arrangements of different kinds can surely appear in a dense star field. But their connection with dark filaments merits further attention.

Now a few words about the dark filaments, which are present in different parts of the sky, usually as some peculiar-

rity of gaseous nebulae. It is to be noted that in the charts of the Palomar Atlas these filaments are much less distinguishable, because of numerous faint stars, which appear in the area of the filaments.

By comparing these features, photographed with different exposures up to different limiting stellar magnitudes, one can evaluate the apparent decrease in the number of stars and consequently the corresponding absorption. This absorption is not very great and generally does not surpass one stellar magnitude.

In the case of the above mentioned dark filaments in the region of McDonald 12 in Cygnus their width at a distance of 1000 parsecs corresponds to nearly 0,3 ps. It is reasonable to assume that their thickness in the line of vision is substantially the same. Adopting now that general absorption of light in this region of space is some 2-3 mg per 1000 parsecs, which corresponds to a density of the order of $6 \cdot 10^{-26}$ gr/cm³, one can arrive to the conclusion that the density of the dust in the dark filaments may attain the value as high as 10^{-22} gr/cm³, or nearly 1000 times greater, than the average for interstellar space. The probable presence of gaseous matter must increase the density still more.

References

I. D.J.Martynov, Astronomical Circular N 149, 1954